Doug Williams

START2

Superfund Technical Assessment and Response Team 2 - Region VIII

United States
Environmental Protection Agency

Contract No. 68-W-00-118

FIELD SAMPLING PLAN

RICO-ARGENTINE
Rico, Dolores County, Colorado

TDD No. 0308-0013

OCTOBER 7, 2003

URS
OPERATING SERVICES, INC.

In association with: Tetra Tech EM, Inc.
URS Corporation
I.T Environmental, Inc.
TN & Associates, Inc.
TechLaw, Inc.

FIELD SAMPLING PLAN

RICO-ARGENTINE
Rico, Dolores County, Colorado

CERCLIS ID# COD980952519

EPA Contract No. 68-W-00-118
TDD No. 0308-0013

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SAMPLING AND ANALYSIS PLAN
Rico Argentine Site
Rico, Dolores County, Colorado

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1.0 INTRODUCTION

URS Operating Services, Inc. (UOS) has been tasked by the U.S. Environmental Protection Agency (EPA), Region VIII, under Technical Direction Document (TDD) #0308-0013, to conduct environmental sampling at Rico, Colorado, as part of a CERCLA assessment/Hazardous Ranking System (HRS) package. The sampling is scheduled to occur in October 2003. This Field Sampling Plan (FSP) is prepared in partial fulfillment of the TDD.

Soil samples will be collected from approximately 40 residential properties in Rico, Colorado. Additional sample locations may be identified during the sampling event. Background samples will also be collected from the Rico area to assess the natural metals levels. In addition to samples from the residential properties, samples will be collected from tailings piles, surface water, and sediment along the Dolores River and Silver Creek to characterize the potential impact of mining activities. Access consents will be obtained prior to sampling activities. The Superfund Technical Assessment and Response Team 2 (START2) will use a Global Positioning System (GPS) to document sample locations and properties sampled. Soil samples will be analyzed on site with an X-Ray Fluorescence Spectrometer (XRF) for the metals indicated in Table 1. A minimum of 10 percent of the total number of samples collected for XRF analysis will be sent to a commercial laboratory for Target Analyte List (TAL) metals analysis as confirmation of field XRF results. The confirmation sample results will be validated in accordance with the criteria contained in EPA guidance documents modified for the analytical method used (U.S. Environmental Protection Agency (EPA) 1994a). Data validation reports will be filed with the data and describe the quality and usability of the data.

This FSP is designed to guide field operations during the collection of samples and to describe the Quality Assurance/Quality Control (QA/QC) measures and procedures that will be implemented.

2.0 OBJECTIVES

The goal of the assessment is to ensure that the data generated during this project are adequate to substantiate a defensible HRS Document Record.

3.0 SITE DESCRIPTION

A brief description of the site features are included in this section. The Site Reassessment document completed by UOS in September 2003 contains a more detailed site description, history, and site characteristics including site geology, hydrology, and hydrogeology (URS Operating Services, Inc. (UOS) 2003).

The Rico-Argentine site is located in the Rico Mountains of southwestern Colorado. The site includes the town of Rico where mining waste reportedly has been deposited (EPA 1993). The site also includes areas of inactive mining and milling operations along the Dolores River and its tributary Silver Creek. The site extends northeast along Silver Creek to the current drinking water intake for the town of Rico and north along the Dolores River to Peterson Slide, which is upgradient of the settling ponds, the heap leach pads, the St. Louis adit, and the location of the proposed drinking water intake for Rico (Figure 1) (EPA 2003).

A total of 19 settling ponds, contained with man-made dikes, have been used for mining activities and water treatment along the Dolores River. During 1996 it was noted that Ponds 16, 17, and 19 had been completely backfilled and Pond 13 had been completely drained of water, but was not backfilled. It was also noted that Pond 10 was full of water, but had no visible connection to the other ponds, and Ponds 1 through 4 had been allowed to become a natural wetland. At the time, only 10 ponds were being used for treating water from the St. Louis Adit. A water treatment process using quick lime has been in use since 1984. The treated water, which flows into the Dolores River after flowing through Pond 5, is regulated under a National Pollutant Discharge Elimination System (NPDES) permit. The settling ponds are located adjacent to and south of the former acid plant and the heap leach pads. The acid plant has been demolished. While in use, the acid plant used Ponds 11 through 18 for holding the calcine tailings. One heap leach pad is located west of the former acid plant area and the other is located in a settling pond used by the former acid plant. The heap leach pads were constructed in 1973 and 1975. Both pads were lined with a Hypalon® liner. Remediation activities have been completed by Rico Development Inc. on at least one of the heap leach pad sites. In 1996 one of the heap leach pads was reportedly being used as a pond to hold dredged material from the uppermost settling ponds (Paser 1996).

Historic mining activity is also apparent along the Silver Creek drainage. Another series of tailings piles, settling ponds, the Blaine tunnel and adit, and the Rico-Argentine mine and mill are located along Silver Creek within the site area.

4.0 BACKGROUND

Mining activities in the Rico area began in the 1860s when several claims were staked in the Pioneer District at the confluence of Silver Creek with the Dolores River. Silver production reached a peak in 1893. Two smelters were built in the area before 1900. Specifically a small smelter was built on the east bank of the Dolores River just north of Rico in 1880 and a second smelter was built at the southern end of town in 1884 (Paser 1996).

In 1902 all of the important mines in the district were consolidated under the United Rico Mine company, which primarily produced base metal ores. The Rico-Argentine Mining Company was formed in 1915 to produce base metal ores. A custom flotation mill was built in 1926 by the International Smelting Company, a subsidiary of Anaconda Mining Company, to concentrate the sulfide ores. The International Smelting Company operated the Falcon Mill located at the north end of Rico between 1926 and 1928. Base metal ore production peaked in 1927, but by 1928 the mill had shut down and all mining activity in the area ceased by 1932 (USGS 1974). The Rico-Argentine Mining Company resumed sporadic mining activities in 1934. Also in 1934, the St. Louis Smelting and Refining Company drove the St. Louis Tunnel and crosscut extensions into the east bank of the Dolores River, causing the tunnel to become a continuous source of mine water discharge into the Dolores River (Paser 1996).

Mining resumed steady production in 1939. A flotation mill, the Argentine Mill, was completed on Silver Creek to process ore from the Argentine Mine (ESA Consultants, Inc. (ESA) 1995; Colorado Department of Natural Resources, Bureau of Mines (BOM) 1939a; BOM 1939b). During 1955 a crosscut from Silver Creek to the St. Louis Tunnel (which discharges into the Dolores River) was completed increasing the flow rate from the St. Louis adit (Paser 1996).

A sulfuric acid plant located north of the settling ponds along the Dolores River was operated between 1955 and 1964 (USGS 1974). During operation, the acid plant deposited calcine tailings into Ponds 11 through 18 (Stephens 1978). The acid plant was closed in 1964 by the state of Colorado for polluting the Dolores River. All mining operations ceased again in 1971 and most of the mine workings were allowed to flood and drain through the St. Louis Tunnel (BOM 1971).

In 1973, the Rico-Argentine Mining Company built a leach pad with the approximate dimensions of 300 feet by 500 feet (100,000 tons) next to the former sulfuric acid plant. A cyanide solution was used to leach silver

and gold from raw ore, and an overflow of an unknown quantity of leaching liquor occurred sometime in 1974 (BOM 1974). In 1975 an additional cyanide leach pad was constructed in a settling pond originally used by the acid plant (BOM 1975). A cyanide heap leach berm failed during 1975, causing an extensive fish kill in the Dolores River and resulting in the immediate closure of the site (Paser 1996).

The Anaconda Copper Company (ACC) acquired the Rico Argentine Mine property in 1980. In response to an outstanding Notice of Violation (NOV) and a Cease and Desist Order (CDO) issued to the Rico-Argentine Mining Company, ACC carried out several environmental efforts. The environmental efforts included building a water treatment plant at the St. Louis Tunnel discharge, capping wells, plugging adits, and stabilizing tailings areas and treatment ponds (Anaconda Minerals Company 1994). Rico Development Corporation purchased the property in 1988 (Anderson 1997). In 1990, a NOV and CDO were issued by the Colorado Department of Public Health and the Environment (CDPHE), formerly the Colorado Department of Health, Water Quality Control Division because of the company's failure to meet the requirements set forth in an NPDES permit, specifically for violations of the NPDES permit discharge levels of lead and silver (EPA 1994b). Additional NOVs and CDOs were issued in 1990, 1993, 1994, and 1996 (CDPHE 1995). EPA records indicate that from January 1992 through May 1998, approximately 96 violations occurred at Rico Development Corporation's mine in Dolores County (EPA 1998b). In addition the U.S. Department of Interior, Bureau of Reclamation, conducted surface water and sediment sampling in the Dolores River and its tributaries between 1989 and 1993. The results show Silver Creek to be a major source of mercury and other heavy metals in the upper Dolores River Basin.

The Atlantic Richfield Corporation (ARCO) initiated a voluntary environmental site characterization and remediation of five source areas around the town of Rico and the surrounding area. The five areas included the Argentine tailings, Columbia tailings, Santa Cruz Mine, Silver Swan Mine, and the Grand View Smelter. Activities occurred between July and November 1996 and included removal of waste rock and tailings material from active waterways and drainages; reconfiguration, consolidation, and stabilization of waste rock and tailings piles to minimize erosion and eliminate slope instability; implementation of source controls to reduce the generation or transport of dissolved metals and capping and erosion protection to minimize the potential for direct human exposure to mill tailings and mine waste rock; and construction of passive treatment features to reduce current metal loadings from adit discharge to receiving waters (Anderson 1997).

Environmental characterization studies have been completed by the EPA, CDPHE, and other government agencies since 1994. In addition, sampling has been completed by or on behalf of various property owners

during ownership. Previous analytical data are summarized in several documents including a Site Reassessment completed by UOS and a Summary of Surface Water and Groundwater Data for Rico, Colorado completed by PTI Environmental Services (UOS 2003; PTI Environmental Services 1995).

5.0 FIELD OPERATIONS

Field operations will be conducted as described below, in accordance with the EPA Region VIII Residential Soil Lead Sampling Guidance Document, START Technical Standard Operating Procedures (TSOPs), the UOS Field Samplers Guide, and the site specific Health and Safety Plan (EPA 2000; UOS 2000; UOS 1998). All non-dedicated sampling equipment will be decontaminated before the collection of each sample in accordance with START TSOP 4.11, "Equipment Decontamination" (UOS 2000). It is not anticipated that investigation-derived waste (IDW) will be generated during this project. Any IDW generated will be contained in accordance with START TSOP 4.8, "Investigation Derived Waste Management" (UOS 2000).

5.1 SAMPLE COLLECTION

Samples will be collected from residential properties within Rico, Colorado, where access has been obtained from the owner. Background soil samples will be collected from the area to determine natural concentrations of metals. Source samples will be collected from tailings impoundments located on the Dolores River and Silver Creek. Surface water and sediment samples will also be collected from the Dolores River and Silver Creek to determine potential impact of the mining activities. Finally, groundwater samples will be collected during site activities to document possible migration of contaminants. No properties will be sampled or surveyed without prior consent from the owner.

5.1.1 Background Samples

A total of two background surface soil samples will be collected from upgradient areas near Rico. Background sample location selections within the selected background area will be based on the sampler's best professional judgement. Background samples will consist of two discrete surface soil samples. The sampling intervals will be from 0 to 3 inches below ground surface (bgs) and samples will be collected using dedicated plastic scoops. If a vegetative layer is present where a background sample is being collected, the soil will be

removed and the vegetation will be returned. It is expected that one background sample will be collected east of Rico and one background sample will be collected west of Rico.

5.1.2 Residential Property Samples

The sampling approach will be biased toward sample locations where contamination is expected to occur and may include soil criteria such as the color, grain size, texture, and other physical characteristics. Appearance of vegetative cover may also be used to determine sample locations.

Residential property samples will be collected from properties that contain a structure where persons reside or business properties that contain areas that may be contaminated. Sample quantities will be determined by the size of the property. For a standard sized lot (5,000 square feet) or smaller, the total area will be considered one sampling zone. A minimum of two composite surface samples and one discreet surface sample will be collected from the sampling zone to determine if elevated metals concentrations exist. Additional samples will be collected if children play areas are identified, if discolored soil material is visible, or if vegetation is stressed at a specific location. If elevated concentrations of lead or arsenic are detected by the on-site analyses, additional samples may be collected to delineate the area of higher concentrations. The locations for any additional samples will be determined at the discretion of the sampler. It is anticipated that three additional samples will be collected per zone. Samples will not be collected at depths greater than 12 inches bgs. Large residential properties will be divided into zones that are no larger than a standard lot and sampled as previously described.

5.1.3 Source Samples

Approximately 13 source samples will be collected from the settling ponds and any tailings piles associated with the mining activities located along the Dolores River and Silver Creek. Exact source sample locations will be determined in the field. The collection of settling pond samples will be determined based on the size, location, and previous use of each pond. Tailings pile samples will be based on the size and location of the pile. A visual characterization of each pond and pile identified will be documented in a site log book. In

addition, a visual estimate of the area and/or volume of each pond and tailings pile will be documented in a field log book for each source, if possible. It is expected that six source samples will be collected along the Dolores River north of Rico (three from the settling ponds, two from the heap leach pads, and one from an adit), four source samples will be collected along Silver Creek (two from the tailings piles, one from an adit, and one from the settling ponds), and three source samples will be collected within the town of Rico (tailings piles located in town along the Dolores River). Additional source samples may be collected if additional sources are identified and indicate a potential health risk.

5.1.4 Surface Water and Sediment Samples

A total of nine surface water samples and nine sediment samples will be collected from the Dolores River and Silver Creek. Specifically seven surface water samples and seven sediment samples will be collected from the Dolores River and two surface water samples and two sediment samples will be collected from Silver Creek. One surface water sample and one sediment sample will be collected above mining activities in each drainage to document metals concentrations before the tailings piles. It is expected that the other sample from Silver Creek will be collected just before the confluence of the Dolores River and Silver Creek. The remaining samples along the Dolores River will be collected from a hot springs seep near the settling ponds, the outfall of the settling ponds, a seep located in the settling ponds, the confluence of the Dolores River and Silver Creek, and the Dolores River south of Rico. Exact locations of the samples will be determined in the field. Surface water and sediment samples will be collocated. Samples will be collected from the most downgradient sample to the most upgradient sample.

5.1.5 Groundwater Samples

Groundwater samples will be collected to document potential migration of contamination. One groundwater sample will be collected from the Ranger Station well as a background sample. Additional groundwater samples will be collected from wells located within the community of Rico. It is expected that two groundwater samples will be collected from domestic wells in the community of Rico.

5.1.6 QA/QC Samples

One duplicate sample will be collected for aqueous samples but will not be identified as duplicates to the laboratory. one matrix spike/matrix spike duplicate (MS/MSD) sample will be collected for each matrix at a rate of 1 per 20 samples collected for laboratory analysis. An aqueous rinsate sample will be collected for each matrix when non-dedicated sampling equipment is used. Rinsate blank samples will be collected at a rate 1 per 20 samples collected for laboratory analysis. Sand rinsate blanks will be collected at a minimum of one per day using decontaminated sampling and sample preparation equipment to identify potential contamination from the sample collection and preparation implements. A field replicate sample will be collected for soil samples to be analyzed using the XRF. Field replicate samples will be collected at a minimum rate of 1 per 20 samples collected. Additional QA/QC requirements that will be adhered to are documented in Section 6.0, Quality Control Requirements.

5.2 DOCUMENTATION

Site activities will be photo documented. Information about each photograph will be recorded in a site log book. Sample information including date and time of collection, location, and any other pertinent information will be documented in a site log book. Any visible evidence of contamination will be documented in a site log book. Each sample location and the area of each tailings pile will be documented using a GPS. This information will be used to produce a map of elevated metals concentrations as well as volumes of waste. All samples will be labeled and chain-of-custody forms will be filled out by UOS for every sample collected. The sample identifier will be written on the sample container with waterproof ink. Information regarding the details of sample collection at a particular area will be entered into the team field log book. In addition to sample collection, the location of the surface water intake for the Rico drinking water system will be field located and then documented using a GPS or a topographic map. The main objective for field locating the surface water intake is to determine if mining activities may impact the drinking water.

5.2.1 Sample Identification

Samples will be identified based on sample location and type of sample. The first field for the sample ID for all samples collected for the Rico-Argentine site will be "RA" to designate the site. The second field will designate the general location of the sample. Samples collected along the Dolores River will be designated DR, samples collected along Silver Creek will be designated SC, samples collected in background areas will be designated BK. The third field will indicate the type of sample collected. Surface water samples will be designated SW, sediment samples will be designated SE, tailings samples will be designated TL, settling pond samples will be designated SP, and soil samples will be designated SO. The last field will designate the number of the sample collected in one group (background, surface water, sediment, source). Additional fields may be added to clarify the location of the sample. For example a background sample collected west of town may have a W added to the identification, or a sample collected from settling pond 19 may have the number 19 added to the identification. Duplicate QA/QC samples sent to the commercial laboratory will be identified in the same manner as the original sample with the exception of the number in the last field, which will be larger by a factor of ten (e.g., AR-DR-SW-01 and AR-DR-SW-11).

5.2.2 Residential Property Soil Sample Identification

Residential property soil samples will be identified based on sample location area. Samples will be designated as follows:

- The first field will be the letters "RA" that designates the sampling event as Rico-Argentine site.
- The second field will be the two letter designation for the specific property owner.
- The third field will be two letters that represent the street on which the property is located.

- The fourth field will be the section or zone number (most sample locations will be considered zone 1). For large properties the zone identifier will be changed to a letter A through Z.

- The fifth field will be the sample depth or the grab surface sample indicator.

  S1 - Grab Surface sample from sample location 1.
  S2 - Grab Surface sample from sample location 2.
  D1 - Grab Depth sample from sample location 1.

- The last field will indicate if the sample is a replicate, duplicate, or equipment blank sample. The last field is for XRF quality control samples only.

  R - Replicate sample.
  D - Duplicate sample.
  B - Sand Rinsate Blank sample.

Example: For a surface sample from zone 1 at the residential property on Soda Street (SD) owned by the owner with the two-letter designator of SM, the sample identifier is RA-SD-SM-1-S1.

5.3 ANALYTICAL PARAMETERS

Soil samples will be analyzed by UOS using a Spectrace 9000® Field Portable XRF. A minimum of 10 percent of the total number of samples collected for field XRF analysis will be sent to a commercial laboratory for TAL metals analyses as confirmation of field XRF results. The samples submitted to the laboratory will also be analyzed for cyanide. Confirmation soil samples will be preserved to 4°C (SW846 Method 6010B/7471/9010). The XRF sample cup will not be sent for confirmation (this may result in slightly higher relative percent differences (RPDs) between the XRF and TAL analysis since different sample aliquots will be analyzed.) Water samples will be sent to a commercial laboratory for TAL total and dissolved metals and total and dissolved cyanide analyses. The acceptable holding times for both soil and water samples are 14 days for cyanide, 28 days for mercury, and six months for all other metals. The definitive laboratory data will be validated using the QA/QC procedures associated with the definitive data. Information pertaining to screening level and definitive data can be found in the Emergency Response Program (ERP) Generic Quality Assurance Project Plan (QAPP) (UOS 1999).

6.0 QUALITY CONTROL REQUIREMENTS

6.1 LABORATORY QUALITY CONTROL

Specific QC criteria have been developed to ensure that the Data Quality Objectives (DQOs) established in the FSP can be achieved. Analytical methods for sample analysis have been selected on the basis of the required detection limits, known contaminants existing in the study area, and the various analytes to be determined. Table 3 of this text presents method numbers, reference guidance, sample containers, sample volume requirements, sample preservatives, and holding times for soil and water samples.

The acceptable decision error limits for the intended data use are presented in Table 4. XRF data will be evaluated as screening data. Laboratory data will be evaluated as definitive data. The Draft ERP Generic QAPP, Section 10.2 "Laboratory Quality Control," contains more specific information related to laboratory QC requirements for definitive data (UOS 1999).

6.2 FIELD QUALITY CONTROL

6.2.1 XRF Analysis

In addition to the samples collected in the field for quality control, a duplicate XRF sample will be prepared in the field lab at a minimum of 1 per 20 soil samples collected for XRF analysis. RPD will be calculated to determine the precision of the sample preparation methods (Appendix A). The RPD will be calculated for lead and arsenic results, when appropriate. The RPD will be calculated by determining the difference of both results, dividing this value by the average of the results, and multiplying that value by 100. Sample preparation is acceptable if the RPD is equal to or less than 35%.

XRF field analytical data will be evaluated as screening data, with an additional ten percent of these samples being analyzed by an independent laboratory for definitive confirmation analysis. All XRF data generated for this project will be evaluated for instrument calibration, detection limits, energy calibration checks, blank checks, and field replicates. The field XRF will be operated per the (Environmental Response Team (ERT) Standard

Operating Procedure (SOP) 1713 and per the manufacturer's specifications (Environmental Response Team (ERT) 1995).

High lead concentrations may mask arsenic concentrations when analyzed on an XRF. The arsenic detection limit for the XRF is either three times the standard deviation of the XRF standard, or one-tenth the lead result, whichever is greater. If lower arsenic detection limits are required, samples will have to be re-analyzed with a longer run time on the XRF, or submitted to a laboratory for analysis by inductively coupled plasma (ICP) analysis or a comparable method.

6.3 CORRELATION OF LABORATORY RESULTS AND FIELD RESULTS

RPD will be used to compare the laboratory and XRF results. RPD will be calculated for analytes that are determined to be of concern. It is expected that arsenic and lead are the analytes of concern. RPD will be determined by calculating the difference between the known value (laboratory result) and the field screening result and dividing the difference by the known result. This value will be multiplied by 100 to determine the percent. An acceptable correlation of results is documented if the RPD is less than or equal to 35%.

7.0 RECONCILIATION WITH DATA QUALITY OBJECTIVES

All data generated for this project will be reconciled with the DQOs presented in this FSP. The data will be assessed for accuracy, precision, completeness, representativeness, and comparability. The data assessment criteria for each of these parameters is described in the ERP Generic QAPP, Section 5.2, "Data Assessment Parameters." This section establishes the methods for calculating accuracy, precision, and completeness, and for evaluating representativeness and comparability using the methods described by EPA guidance. Generally, data that do not meet the established acceptance criteria are cause for re-sampling and re-analysis. However, in some cases, data that do not meet acceptance criteria are usable with specified limitations. Data that are indicated as usable with limitations will be included in the final report, but will be clearly indicated as having limited usability. Indicators of data limitations include data qualifiers, quantitative evaluations, and narrative statements regarding potential bias. The ERP Generic QAPP, Section 14.0, "Reconciliation with Data Quality Objectives," contains specific requirements for reporting of data usability (UOS 1999).

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URS Operating Services
START2, EPA Region VIII
Contract No. 68-W-00-118

Rico Argentine
Revision: 0
Date: 10/2003

Horse Creek

Rico Ranger Station

Old Acid Plant (demolished)

St. Louis Tunnel Adit

St. Louis Ponds

Old Heap Leach Pad

Aztec Gulch

Outfall 002

Rico Municipal Surface Water Intake

Silver Creek

Blaine Adit

Rico-Argentine Mill and Tailings Ponds

Iron Draw

Atlantic Cable Mine

Historic Grand View Smelter Site

Shamrock Mine Waste

Van Winkle Mine

Rico

Pro Patina Mill Tailings

Columbia Tailings

Santa Cruz, Iron Clad, and Rico Boy Mines

Sulphur Creek

Spear Slide

Silver Swan Mine

Deadwood Gulch

Burnett Creek

145

Rico Town Park

Spruce Gulch

Dolores River

Fall Creek

Scotch Creek

Old Montelores Bridge
(Gauging Station)

4000' 3000' 2000' 1000' 0 4000'

SCALE: 1" = 4000 feet

Dolores County
Montezuma County

New Bridge

Legend

Tailings/Settling Ponds

Wetlands

Source: USGS 7.5 Minute Topographic Quadrangle: Rico, Colorado 1960

Source: URS Sample Location Map 1996

Field Sampling Plan
TDD No. 0308-0013

Rico Argentine
Dolores County, Colorado

Site Location Map

Figure 1

October 2003

URS OPERATING SERVICES

TABLE 1
XRF vs. TAL Metals Analysis

Element		XRF Analysis	Laboratory Confirmation by TAL Analysis
Aluminum	(Al)		X
Antimony	(Sb)	X	X
Arsenic	(As)	X	X
Barium	(Ba)	X	X
Beryllium	(Be)		X
Cadmium	(Cd)	X	X
Calcium	(Ca)	X	X
Chromium	(Cr)	X	X
Cobalt	(Co)	X	X
Copper	(Cu)	X	X
Iron	(Fe)	X	X
Lead	(Pb)	X	X
Magnesium	(Mg)		X
Manganese	(Mn)	X	X
Mercury	(Hg)	X	X
Molybdenum	(Mo)	X	
Nickel	(Ni)	X	X
Potassium	(K)	X	X
Rubidium	(Rb)	X	
Selenium	(Se)	X	X
Silver	(Ag)	X	X
Sodium	(Na)		X
Strontium	(Sr)	X	
Thallium	(Tl)		X
Thorium	(Th)	X	
Tin	(Sn)	X	
Titanium	(Ti)	X	
Uranium	(U)	X	
Vanadium	(V)		X
Zinc	(Zn)	X	X
Zirconium	(Zr)	X	

TABLE 2
Environmental and Quality Control Sample Quantities for Environmental Analyses

Sample Matrix	Analysis	Quality Control Samples					
		Lab QA/QC			Field QA/QC		
		Standard Reference Samples	Laboratory Blank	Matrix Spike and Duplicate	Blank	Field Replicates	Equipment Rinsate
Water	ICP/CVAA/GFAA	1 per 20 samples	1 per 20 samples	1 per 20 samples	N/a	1 per 20	1 per day*
Soil	XRF	>7 per day	2 or 3 per day	N/A[1]	1 per day	1 per 20	1 per day*
Soil	ICP/CVAA/GFAA	1 per 20 samples	1 per 20 samples	1 per 20 samples	N/A	N/A	1 per day*

1 No matrix spike performed during XRF analyses.
* When non-dedicated sampling equipment is used.
N/A Not applicable.
CVAA Cole vapor atomic absorption
GFAA Graphite furnace atomic absorption
ICP Inductively coupled plasma

TABLE 3
Environmental Sample Collection and Laboratory Analysis Specifications

Analysis[b]	Analytical Method	Reference	Container	Required Volume	Preservation	Holding Time[a]
TAL Metals - XRF	ERT SOP 1713	SW846	Seal top poly bag to XRF Sample Cup	2 cups	NA	6 months 28 days Hg
TAL Metals in Soil except Mercury	6010B	SW846	8 oz HDPE	2 gm	NA	6 months
TAL Metals in Soil - Mercury	7471	SW846	8 oz HDPE	0.2 gm	NA	28 days
Soil - Cyanide	9010	SW846	8 oz HDPE	25 to 100 gm	NA	14 days
TAL Metals in Water except Mercury	6010	SW846	1 Liter HDPE	200 mL	HNO_3 to pH <2	6 months
TAL Metals in Water - Mercury	7471	SW846	1 Liter HDPE	100 mL	HNO_3 to pH < 2	28 days
Water - Cyanide	6010	SW846	1 Liter HDPE	500 mL	NaOH to pH > 12	14 days

a Holding times begin from the time of sample collection in the field.
b Complete Target Analyte List (TAL) of metals will be requested for all inductively coupled plasma (ICP) analyses.
TBD To be determined.
Hg Mercury.
HDPE High density polyethylene
gm Grams
mL Milliliter
NA Not applicable.
HNO_3 Nitric acid
NaOH Sodium hydroxide

TABLE 4
Quality Assurance Objectives for Environmental Samples

Analysis (for each matrix)	Analytical Method	Data Type	Units	Detection Limits	Accuracy %	Precision %	Completeness %
Soil - XRF	XRF	S/D	mg/kg	Pb - 40 As - 50	50-120	±35	90
Soil - ICP/CVAA	SW846 - 6010B/7471/9010	D	mg/kg	< 1.0	50-120	±35	90
Surface Water	SW846 - 6010B/7471/9010	D	µg/L	5-5,000/0.2	75-125	±25	90

Data type refers to the following:
S/D = non-definitive data with 10% definitive confirmation;
D = definitive data.

mg/kg Milligrams per kilogram.
µg/L Micrograms per liter.
ICP Inductively coupled plasma.
CVAA Cold vapor atomic absorption.

APPENDIX A

XRF Sample Preparation Method

Site Specific XRF Sample Preparation

XRF sample preparation will follow the general guidelines set forth below:

- Each sample will be collected in a seal top poly bag, homogenized, labeled with the appropriate sample identification, and transported to the field laboratory work space for XRF analysis.
- A portion of the sample will be placed in a container for drying on a griddle, or in an oven at temperatures not to exceed 60°C, or by air drying. All containers will have identification tags containing a number that will be cross-referenced to the sample number. Both identifiers will be documented in the START2 XRF Sample Preparation Log.
- Once the samples are dry, they will be sieved using nylon lead-free sieves. A 60-mesh sieve (250 μm) will be used for grab surface samples. Samples placed on top of the screen will be shaken, swirled, tapped, and bumped until all the particles smaller than 60-mesh for the composited surface samples have fallen through the top sieve. The sample will not be ground or forced through the sieve. The discrete depth samples may be sieved with a 10-mesh screen.
- The collection tray will be emptied into an XRF sample cup. The drying and sieving of additional sample material may be repeated until the XRF sample cup is filled. The sample cup will be covered with 0.2-mil Mylar® or polypropylene film. The sample cup will be tapped on a table top to pack the sample against the window film.
- Sample will be analyzed as stated in the text of this document. Sample calibration, calibration checks, and samples analyzed will be documented in the START2 XRF Analysis Log.
- Non-dedicated sieves, collection trays, and any other implemen5ts used will be decontaminated between each sample.

If the sample was dry enough to flow through the mesh sieve easily, a dry decontamination will be used. The screen and pan will be wiped with paper towel and the screen brushed with a brass brush.

If the sample did not flow through the sieve easily, a wet decontamination will be used. The screen and pan will be washed with a Liquinox® solution, rinsed with potable water, and dried in an oven or with a hair dryer.